Space Weather Technical Forecast

Issued on Monday, 24 June 2024 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-class flares (R1-R2 radio blackouts) expected. Chance of isolated X-flares (R3 radio blackouts). Chance of S1/Minor radiation storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with three M-class flares during the past 24 hours. The largest was an M9.3 flare, which was observed at 23/1301 UTC and originated from AR3723 close to the southeast limb. There are currently eleven sunspot regions on the visible disc. AR3713 is currently the largest and the most magnetically complex, with both a beta-gamma configuration and a delta in the leading spot. AR3712 is the second largest on the disc, with a delta portion in its trailing region, but this spot is now partially around the limb and further analysis will become increasingly difficult. AR3716 in the northwest also approaches the west limb, with little change in recent hours. AR3720 in the southeast has developed a delta spot within its intermediate region. The recently numbered AR3723 on the southeast limb continues to emerge, which now appears longer, with several spots all with mature penumbra. A more detailed analysis of this region will be conducted as it continues to rotate into a better view. All other regions are simple and stable.

No Earth directed CMEs have been observed in coronagraph imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE at L1, were at background levels, ranging from 300-380km/s, due to a weak connection to CH47/-, with a possible CIR ahead of the HSS during 23 Jun. Density was mostly average or below. Interplanetary Magnetic Field, Bt, was weak initially, but rose to moderate after 23/0600 UTC, peaking at 12nT. The north-south component, Bz, followed a similar trend, becoming moderately negative for a period between 23/0600-0930UTC with a peak of -11nT. Phi angle was predominantly positive (away from the Sun) but became increasingly negative (toward the Sun) during 23 Jun. Geomagnetic activity was Quiet (Kp 1-2) but became Unsettled to Active (Kp 3-4).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels with no solar radiation storms occurring. High energy electron flux (greater than 2MeV) observed by GOES16 was diurnally moderate, but became background due to HSS from CH47/-. The 24-hour fluence was below Active on a slight rising trend, reaching 3.24e6 integrated pfu at 24/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-flares are expected, with a chance of isolated X-class flares, most likely from AR3712, AR3713 or AR3716, though these risks reducing with time.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs are expected. Solar winds remain within background levels. Similar speeds are expected for much of, if not the entire

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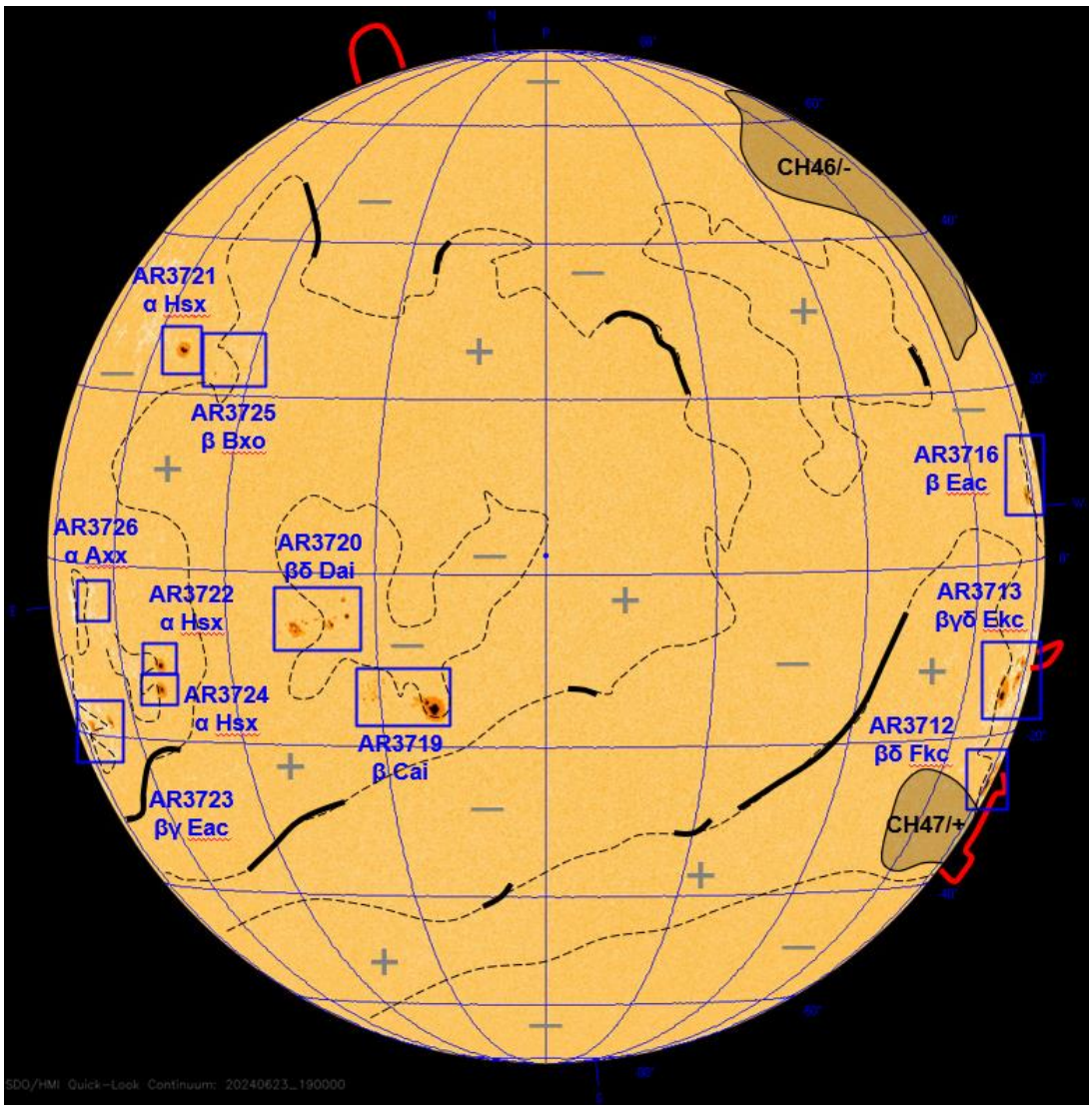
forecast period. There is an outside chance of minor coronal hole enhancements day 1-2 (24-25 Jun).

Overall mainly Quiet to Unsettled geomagnetic activity is expected. There is a chance of Active intervals and a very slight chance of G1 Minor Storms days 1-2 (24-25 Jun), should there be any further coronal hole connections or weak transients.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background levels, but with a chance of exceeding the S1/Minor Storm threshold should any notable flares occur from any of the three large sunspots in the western hemisphere. High energy electron flux is forecast to be at predominantly background levels. The associated 24-hour fluence is expected to remain well below the Active threshold.

Figure 1. Solar Analysis Valid 23/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
No Earth directed CMEs are evident in imagery, however, given the number of CMEs in recent days there is some slight uncertainty in this aspect of the forecast.

Although solar winds remain within normal background levels, we have seen a slight rise in speeds due to a weak connection to CH47/- in the northwest of the disc, with a possible CIR ahead of the CH/HSS during 23 Jun. Similar speeds are expected for much of, if not the entire forecast period. MOSWOC Enlil continues to overestimate solar winds due to CH46/-, but given the minor enhancement on 23 Jun, the risk of further enhancements is thought to be minimal. Any geomagnetic response is expected to be limited at this time of year (around the solstice). There is an outside chance of a minor coronal hole enhancement from CH47/+ on days 1 and 2 (24 and 25 Jun), but also thought to be unlikely, given its southerly latitude.

Overall mainly Quiet to Unsettled geomagnetic activity is expected. There is a chance of Active intervals and a very slight chance of G1 Minor Storms days 1-2 (24-25 Jun), should there be any further coronal hole connections or weak transients.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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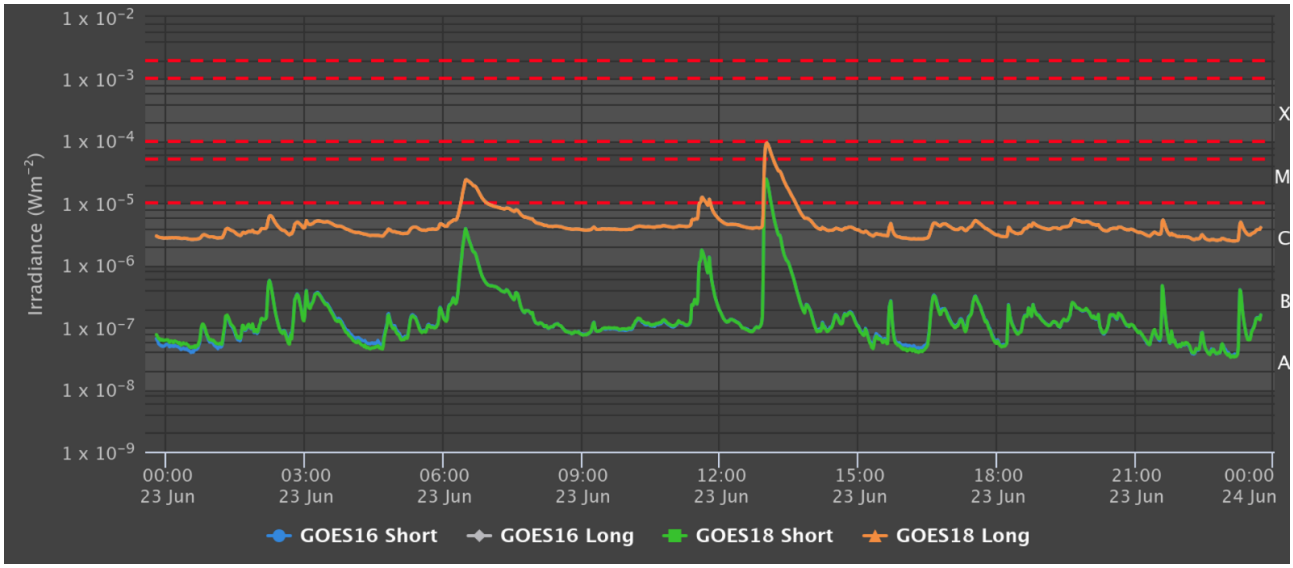
Radio Blackouts - X-Ray Flares:
There are currently eleven sunspot regions on the visible disc. AR3713 is currently the largest and the most magnetically complex, with a beta-gamma-delta configuration. AR3712 is the second largest on the disc, with a delta spot in its trailing region, but this spot is now partially around the limb and further analysis will become increasingly difficult. AR3716 in the northwest also approaches the west limb. AR3720 in the southeast has developed a delta spot within its intermediate region. The recently numbered AR3723 on the southeast limb continues to emerge, which now appears longer, with several spots all with mature penumbra. All other regions are simple and stable. This region is probably Ex-AR3664/Ex-AR3697 from previous rotations, which has a history of producing significant flares, so worth keeping an eye on this as it continues to rotate round onto the disc.

AR3712 and AR3716 are due to rotate off the visible disc on day 1 (24 Jun) and AR3713 on day 2 (25 Jun), but will still pose a threat for significant flares just beyond the western horizon. A decreasing risk of flares will likely be observed as the above three spots rotate further around the far side toward the end of the period.

Further M-class flares are expected initially, with a chance of isolated X-class flares, mainly from AR3712, AR3713, AR3716 or perhaps from a returning region around the southeast limb, though this risk reducing with time.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	70	50	50
Very Active	R3 to R5 X Class	No	25	20	10	10

Figure 2: GOES-18 X-Ray Flux



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Solar Radiation Storms - (High Energy Protons):

GOES-18 proton flux remains at background levels, with no solar radiation storms observed. However, any significant flares, particularly from any of the three larger regions (AR3712, AR3713 or AR3716) in the western disc as they round the western limb, have the potential to increase the observed flux and brings a chance of exceeding the S1 Minor Storm threshold. A decreasing risk will likely be observed as the above three spots rotate further around the far side toward the end of the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	30	20	10	5
Very Active	**≥ S3 ***	No	5	2	2	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, has been reaching diurnally moderate levels post enhancement from CH45/+. Electron flux has now been suppressed from the minor solar wind enhancement from either a weak transient or CH46/-. Mainly background electrons are expected for the remainder of the period.

Associated electron fluence is expected to persist well below the Active threshold (1e8 integrated pfu), with MOSWOC REFM output considered to be good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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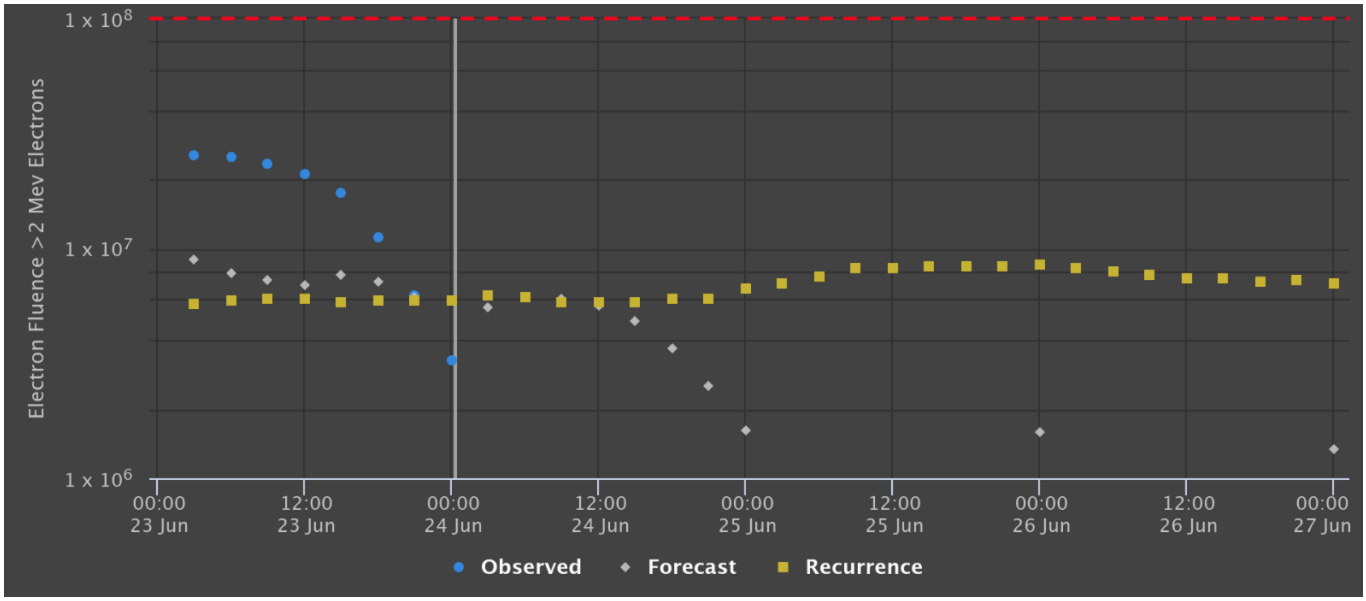
Figure 3: MOSWOC REFM electron fluence



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